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CAMBIAL DIEBACK AND TAPHOLE CLOSURE IN SUGAR MAPLE AFTER TAPPING

Abstract.—Dead cambial tissues adjacent to tapholes were found to be elliptical in shape and to average 1.6 inches in length and 0.2 inch in width. Chemical and physical treatments designed to stimulate the growth of callus tissues surrounding tapholes were not successful. Nearly all the tapholes, both treated and untreated, had closed after three growing seasons.

Maple sap producers annually drill one to four or more tapholes into their sugar maple trees. These holes are usually 7/16 inch in diameter and 2 to 4 inches deep. The damage caused to the tissues around the taphole is both internal and external. Internal damage results in discoloration of the wood in streaks about ½ inch wide, extending approximately 18 inches above and 18 inches below the taphole. External damage results in the dying of cambial tissues around the hole.

Both types of damage are important. However, the dieback of cambium may be of more concern to the syrup producer, because a tree cannot be tapped again at the same location until the hole has closed and is covered with a layer of wood equal to the taphole depth.

If a taphole closes rapidly, the same area can be tapped again sooner than if the taphole closed slowly. Also, the closing of the taphole tends to inhibit the advance of aerobic decay organisms. The more rapidly the taphole closes, the less chance there is for the decay organisms to gain a foothold in the tree tissues (*Shigo and Larson 1969*).

In an attempt to define and solve this problem, we made two studies at the same time: one to determine the amount of cambial dieback resulting from normal tapping procedures, and another to test several treatments designed to accelerate taphole closure. For both studies, the tapped trees were about 150 years old, averaging 26 inches d.b.h.; and the sugarbushes had a history of severe grazing.

We found that the pattern of dieback was elliptical in shape, averaging 1.6 inches in length and 0.2 inch in width. This dieback pattern was not influenced by spout materials —metal or plastic—or by the use of paraformaldehyde pellets. Chemical and physical treatments to the tissues around the tapholes failed to accelerate callus formation.

Damage to Cambial Tissue

To evaluate the damage to cambial tissue surrounding the taphole, 4 tapholes were drilled in each of 10 trees. All tapholes were 7/16 inch in diameter, drilled to a wood depth of 3 inches. One of the following four treatments was assigned at random to one taphole on each tree.

1. Galvanized metal spout without 250-mg. paraformaldehyde pellet.
2. Galvanized metal spout with 250-mg. pellet.
3. Plastic spout without 250-mg. pellet.
4. Plastic spout with 250-mg. pellet.

The trees were tapped in late February, and the spouts were removed in mid-April. In early July, the bark around each taphole was removed, exposing all the dead cambial tissue beneath (fig. 1). The length and width of the affected area was measured to the nearest 0.01 inch. Taphole dimensions were excluded in these measurements.

The differences in width and length of cambial dieback around each taphole were ana-

Figure 1.—A section of bark and wood removed from a sugar maple tree to reveal the dieback of cambial tissue as a result of tapping. Left, the bark side; right, the under side.

lyzed, using an analysis of variance. The spout material, whether galvanized metal or plastic, and the use of paraformaldehyde pellets, did not significantly affect the amount of dieback:

Treatment	*Average cambial dieback*	
	Length (inches)	*Width (inches)*
Metal spout without pellet	1.42	0.18
Metal spout with pellet	1.46	0.18
Plastic spout without pellet	1.34	0.14
Plastic spout with pellet	2.00	0.14
Average	1.56	0.16

The length of cambial dieback for the plastic spouts with a pellet—2.00 inches—was greater than that of the other three treatments. However, the difference was not statistically significant at the 5-percent level. Differences in width of dieback were very small. Similar results were reported by Nyland and Rudolph (*1969*).

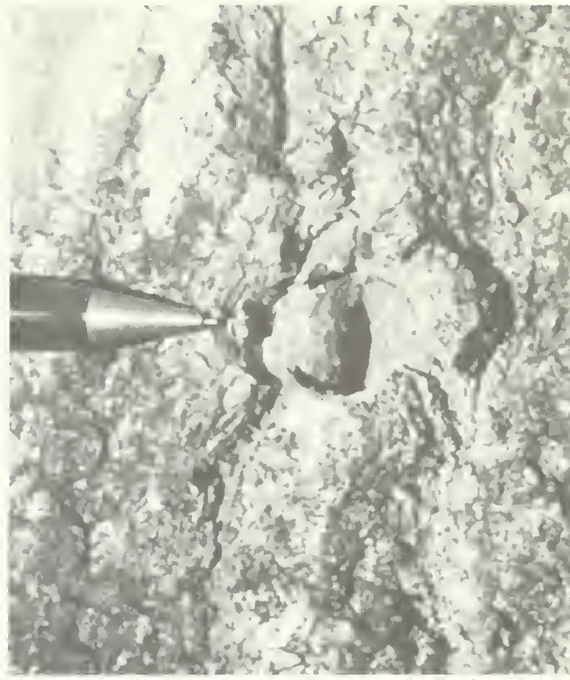

Figure 2.—Growth of callus tissue is closing this taphole. Most tapholes close in about 3 years.

Taphole Closure

Taphole closure follows a pattern similar to that of healing in a pruning wound. Layers of callus tissue develop from live cambial tissue on each side of the taphole. With each successive layer, the callus converges toward the center of the taphole (fig. 2).

A total of 21 treatments were tried, including physical, chemical, and combinations of both physical and chemical. These treatments were as follows:

Physical.—At the end of the sugaring season in mid-April, tapholes were reamed with a ½-inch drill bit; pellets were washed from the taphole in mid-April.

Chemical.—Reamed tapholes were sprayed with traumatic acid at 300 and 1,200 p.p.m.; 2,4-D at 100 and 1,000 p.p.m.; indole-3-acetic acid at 300 and 1,200 p.p.m. Unreamed tapholes were sprayed with traumatic acid at 500, 1,000, and 2,000 p.p.m.; 2,4-D at 200, 800, and 1,600 p.p.m.; 2,4,5-T at 500, 1,000, and 2,000 p.p.m.; indole-3-acetic acid at 300, 500, and 1,800 p.p.m.

The 2,4-D and 2,4,5-T are synthetic auxins that can be growth stimulators when used in low concentrations (*Wells 1955*). All chemicals were mixed with distilled water.

For all treated tapholes we also had control or untreated tapholes for comparing data results.

We were unable to stimulate the formation of callus tissue around the tapholes; in fact 95 percent of the untreated tapholes healed after 3 years, and only 87 percent of the treated tapholes healed during the same period. One treatment—2,4,5-T at 2,000 p.p.m.—seemed to inhibit taphole healing, because 6 of the 10 treated tapholes showed no evidence of closure after 3 years.

Summary and Discussion

Results of our first study revealed that dead cambium associated with tapping was elliptical in shape and averaged 1.6 inches long and approximately 0.2 inch wide. The amount of cambium killed did not vary with any of the taphole treatments. The great difference between the length and width of damage may be due to the fact that there is little lateral translocation in tree tissues. Therefore, cambium on either side of the taphole was protected from any potentially harmful substances resulting from tapping. Also, and probably more

important, driving spouts compresses tissues on the sides of the taphole, and spouts will often split the cambium tissues above and below the taphole.

In our second study, most of the tapholes closed in 3 years, regardless of chemical or physical treatments designed to promote the growth of callus tissue. The reason for failure of the treatments is not clear, but there are at least three possibilities. First, chemical treatments were not in contact with the living tissues long enough to be effective. The use of a carrier more persistent than water, such as lanolin, might have improved the effectiveness of the chemicals. Second, the treatments may not have reached the living tissue. We know that tissues around the taphole are killed very quickly (*Shigo and Laing 1970*), and the combination of heavy bark and dead cambium may have shielded the living tissues from both chemical and physical treatments. Third, the chemicals used in this study may not have been adequate growth stimulators for sugar maple cambial tissues.

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